

Conditional access method and devices

The invention relates to the devices and methods for processing a conditional access stream.

5 US patent No. 5,799,081 describes a use of an encrypted data stream. This patent discusses an MPEG transport stream that provides for conditional access to data. MPEG conditional access is managed by two types of messages: Entitlement control messages (ECM) and Entitlement management messages EMM's. A secure device (e.g. smart card) in a stream receiver receives both ECM's and EMM's. The ECM's and EMM's provide
10 the broadcaster of an MPEG transport stream control over whether individual stream receivers can access the stream.

The ECM's contain control words (keys CW) for use by all entitled stream receivers to decrypt data such as video data. The necessary control words CW are changed regularly, for example every 10 seconds, and ECM's are provided at an even higher
15 frequency, for example every tenth of a second. Typically, the secure device decrypts the control words CW from the ECM's and supplies these control words to a decoder that uses the control words to decrypt data such as video data.

The EMM's are used to control which stream receivers are entitled to decrypt data. The EMM's are directed at individual stream receivers and are used to instruct the
20 secure device of a stream receiver whether it should make the control words CW available for decrypting data. This may involve providing the necessary keys for decrypting ECM's and/or other instructions about entitlement. Typically the transmission of EMM's is dependent on payment of a subscriber fee for a particular stream receiver.

US patent No. 5,799,081 describes how copy control information can be
25 included in the ECM's. Thus the ECM's are used in a recording system to prevent that too many copies are made of an MPEG transport stream.

The possibility to tamper with EMM's forms a weak point of this type of conditional access stream. If an EMM contains an instruction to disable decryption at a stream receiver, a hacker can prevent disabling by blocking transfer of the EMM to the

secure device. Similarly, by supplying a falsified EMM, or a copy of an old, enabling EMM entitlement can be tampered with. Of course, various precautions can be taken against this, but these measures are not always watertight. Moreover, such measures may require additions to the secure device, such as a time of day/calendar counter that are not always 5 compatible with smart cards.

Among others, it is an object of the invention to provide measures that control conditional access to an encrypted data stream in a way that make it more difficult to get 10 access to the stream by tampering.

According to the invention management information for disabling decryption in selected stream receivers is included in messages, such as ECM's, that supply control 15 words for decrypting data. Thus, at least some ECM's are made "poisonous" for selected stream receivers. The idea behind this is that hackers on one hand need to supply ECM's to the secure device to profit from the stream and on the other hand cannot determine beforehand which ECM's are poisonous for their secure device.

Accordingly a device for generating a stream is provided that adds "poison" 20 information directed at selected stream receivers to messages with control words for decrypting the stream. A secure device is provided that uses messages with control words to supply control words from the messages, but also detects whether these messages contain "poison" information directed at the secure device and, if so, such a secure device indefinitely disables supply of control words. (By indefinitely is meant not for a predetermined normal 25 period, such as a subscription period or the period of validity of a control word). Disabling may be performed in a similar way as for EMM processing, but preferably special forms of disabling are available for disabling in response to ECM's, such as completely and permanently disabling the secure device, or disabling all programs from a specific supplier until further notice, removing or disabling keys needed for decryption etc.

The poisonous ECM's are targeted at selected secure devices for example by 30 specifying a condition in the ECM that must be met by entitlement information that is stored in a secure device. In response to the ECM the secure device disables decryption if it detects any entitlement information that meets the condition. Thus, a system manager can cause all

secure devices to start searching for the presence of falsified entitlement information that has not been supplied normally.

5 These and other objects and advantages of the invention will be described in a non-limitative way using the following figures.

Figure 1 shows a conditional access system

Figure 2 shows a flow chart of the operation of a secure device

Figure 3 symbolically shows a stream.

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Figure 1 shows a conditional access system. The system comprises a transmitter/multiplexer 110, which receives inputs from a data source 100 via a data encryption unit 106, from a control word source 102 via an ECM generator 108 and from a source of management information 104. Control word source 102 supplies encryption control words to data encryption unit 106. Source of management information 104 supplies management information to ECM generator 108.

Furthermore, the system comprises a plurality of stream receivers 12 (only one shown explicitly). Each receiver comprises a demultiplexer 120 with outputs coupled to a secure device 122 and a decoder 128. In the secure device measures (known per se) have been taken against tampering. The secure device is typically a smart card. The secure device 122 is shown to contain a processor 124 and a memory 126. Processor 124 has an output coupled to decoder 128 and decoder 128 has an output coupled to an output of stream receiver 12.

25 In operation transmitter/multiplexer 110 receives and multiplexes encrypted content data, ECMs and EMMs and transmits the resulting stream to a plurality of stream receivers 12. The stream receivers demultiplex the stream, and decrypt the content data if the secure device 122 so permits.

30 Figure 3 symbolically shows a stream made of messages, including ECM's and EMM's interspersed between content data.

Data source 100 produces content data, such as audio and/or video data, which is encrypted by data encryption unit 106 for transmission by transmitter/multiplexer 110. Decoder 128 receives the encrypted content data and if it receives the appropriate control

words from secure device 122 it decrypts the content data and supplies the decrypted content data at its output.

Source of management information 104 generates EMM's with instructions for secure devices in individual stream receivers 12 or groups of stream receivers 12.

5 Demultiplexer 120 demultiplexes the transmitted EMM's from the stream and supplies them to secure device 122. Processor 124 of secure device 122 detects whether the EMM is directed at the particular secure device 122 and, if so, executes the instruction that is implied by the EMM, for example by updating entitlement information and/or keys in memory 126. Entitlement information indicates for example information to identify programs from the
10 stream that stream receiver 12 is entitled to decrypt, and/or the time and date at which stream receiver 12 is entitled to decrypt etc. Typically the entitlement information for a particular stream receiver 12 depends on whether or not the user of the stream receiver 12 has acquired a subscription for a particular service and/or has paid subscription fees.

Control word source 102 generates control words for encrypting the data from
15 data source and corresponding control words for decrypting the encrypted data. Typically the control words are changed every few seconds, e.g. every ten seconds. Data encryption unit 106 uses the encryption control words to encrypt the content data and ECM generator 108 includes the control words for decryption in ECM messages, which are transmitted contemporaneously with, or slightly before the content data that can be encrypted with the
20 control words. Demultiplexer 120 demultiplexes the transmitted ECM's from the stream and supplies them to secure device 122. Processor 124 of secure device 122 tests whether information in memory 126 indicates that the secure device is entitled to permit decryption with the control word from the ECM and, if so, processor 124 extracts the control word from the ECM (typically by decrypting the ECM) and supplies the control word to decoder 128.

25 According to the invention source of management information 104 also supplies management information to ECM generator 108 and ECM generator 108 includes this information in the ECM's (however, without deviating from the invention the management information may also be supplied externally). Typically, this is "poison" information, instructing selected secure devices 122 to disable decryption of content
30 information. Processor 124 in secure device 122 is programmed to inspect received ECM's to detect whether it contains such poison information directed at the particular secure device 122. If so, processor 124 updates the entitlement information in memory 126 so as to disable supply of control words to decoder 128, at least for an identified period or program from the stream, but preferably for all programs, or for all programs from a selected program provider.

In this embodiment processor 124 gives effect to the information from the ECM much like it gives effect to information from EMM's. In another embodiment processor 124 is arranged to disable secure device 122 in a more irreversible way, for example by blowing a fuse that enables operation.

5 The management information supplied to ECM generator 108 and included in the ECM's may also be conditional, e.g. in the form of a command to secure devices 122 to disable decryption if certain data in its memory (e.g. among the entitlement data) meets a condition specified in the command. In response to the command, secure device 122 searches its memory to detect whether there is data that meets the condition, and if so executes the
10 disable operation. The condition may for example test for entitlements of a type that have not been issued in the EMM's, having for example aberrant periods of validity. Also, the condition may test for a type of entitlement that is needed to decrypt a stream that has been transmitted (or is being transmitted), but for which no entitlements have been transmitted in EMM's for at least for a group of users. The secured device of hackers who have constructed
15 entitlement information for this stream are thus detected. In addition to the condition one may include an identification of a secure device or a group of secure devices for which the command is intended. Instead of conditional disabling, conditional enabling (e.g. for a specified period) may also be used.

Figure 2 shows a flow chart of the operation of processor 124. In a first step 21 processor 124 receives a message and tests whether this message is an ECM or an EMM. The test may also be performed before the message is supplied to processor 124, using for example a identification information from the stream. In this case selectively only ECM or EMM's may be supplied to processor, optionally with additional information to distinguish ECM and EMM's. If the message is an ECM processor 124 executes a second step 22, decrypting the ECM, optionally checking whether the syntax of the ECM is correct and optionally verifying whether the ECM is authorized (such a check is known per se). In a third step processor 124 tests whether the decrypted ECM contains poison information addressed at the secure device to which the processor belongs, e.g. by comparing an address ID value in the ECM with an ID code in the secure device 122. If there is no poison information for the
25 secure device, processor 124 executes a fourth step 24, to extract one or more control words from the ECM. In a fifth step 25 processor 124 supplies the control word or words to decoder 128. Subsequently the process returns to first step 21.
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When in first step 21 processor 124 detects an EMM, processor 124 proceeds with a sixth step 26, decrypting the EMM if necessary and optionally authenticating the

EMM; decryption and authentication are known per se (it will be noted that different decryption keys are generally used for decrypting ECM's and EMM's, the decryption key for decrypting ECM's being common to all secure devices that have access to a stream).

Subsequently, in a seventh step 27 processor 124 extracts management information from the 5 decrypted EMM. In an eight step 28 processor 124 uses this management information to update entitlement information or keys in memory 126. Subsequently the process returns to first step 21.

When in third step 23 processor 124 detects that the ECM contains poison information for the secure device, processor 124 executes steps to give effect to the poison 10 information. In one embodiment these may be the same steps as those used for effecting EMM's, in order to modify entitlements, but preferably dedicated steps are used, which alter the functioning of the secure device in a way that cannot be undone by any EMM. Thus hackers that are able to falsify EMM's cannot prevent countermeasures.

In the embodiment wherein the steps of EMM processing are used processor 15 124 executes a ninth step 29 and proceeds to eighth step 28, now using management information from the ECM (instead of information from an EMM) to update entitlement information in memory 126, or to disable supply of control words for certain programs or all programs altogether until further notice.

Optionally, in this case when the entitlement information comes from an 20 ECM, processor 124 may proceed to fourth step 24 after eighth step 28, as shown by dashed line 20. Thus, it is not immediately visible to a user that the ECM did contain poison information. This makes it more difficult for hackers to screen ECM's for ECM's with poison information.

Although, as shown, program steps that are used for EMM's may be reused for 25 entering information received from ECM's as well, one may of course use steps dedicated to entering management information from ECM's (for example by providing dedicated computer programs to processor to do so). Thus, it is possible to execute functions that are not available for EMM's. Processor 124 may for example be arranged to enter additional control data (not conventional entitlements) into memory for blocking decryption. During 30 processing of subsequent ECM's processor 124 may each time test this additional control data to determine whether control words from the ECM's may be supplied for decrypting a program in the stream, or for any program in the stream, or for a group of programs from the same program supplier.

It is also possible to add a function to disable the secure device altogether in response to a command from an ECM, or to overwrite or disable certain keys that are needed in the secure device for supplying control words. Similarly, a countdown value may be entered, processor 124 counting ECM's until a number of ECM's corresponding to 5 countdown value has been counted, after which effect is given to the poison information.

Processor 124 may use various methods to decide whether an ECM is targeted at the secure device of which processor 124 is part. In one example, the management information contains an identification of the secure device for which the poison information is intended. In this case, processor 124 compares this identification with an identification that 10 is stored in the secure device and gives effect to the poison information (disabling supply of control words) only if the identification matches.

In another example the ECM contains a conditional command, specifying an entitlement, or properties of an entitlement that must be present. If processor 124 detects such a command in an ECM, it searches memory 126 for an entitlement that meets the condition. 15 Only if processor 124 finds such an entitlement processor 124 gives effect to the poison information (disabling supply of control words).

Typically, a system manager decides to distribute poison information in cases where the manager fears that specific secure devices may be used for tampering. For example to disable a secure device when no subscription is extant any longer for that secure device, or 20 to specifically disable decryption of certain programs that the subscriber has not validly subscribed to. This type of poison information is preferably included in ECM's at random, so that it cannot be predicted when an ECM will contain poison information for a specific secure device. For this purpose source of management information 104 preferably contains a random generator to decide when and in which ECM's to include poison information for a 25 selected secure device 122 that has to receive such information.

As another example, if the system manager finds out that hackers have succeeded in falsely creating a certain type of entitlement information, the system manager can decide to start broadcasting ECM's command with a condition that causes the secure devices to tests for entitlement information of this type and to disable decryption if this type 30 of entitlement is detected (provided of course that untampered secure devices do not, or do no longer, contain such entitlements). A system manager could also intentionally broadcast a program for which no entitlements are supplied at all. If hackers, in an excess of enthusiasm, create entitlements for this program, supply of a command to disable secure devices for all

programs that if they contain such entitlements can be used as a countermeasure against hacking.

Although the invention has been described in terms of ECM's, it will be appreciated that the poison information may be included in any message that contains information (control words) that is vital to decrypting content data. It will be appreciated that not all such ECM-like messages need to include such poison information. Indeed different ECM's may contain poison information for different secured devices. However, since normal management information is supplied using EMM's relatively many ECM's may contain poison information directed at specific secure devices. From transmitted ECM's it is not possible to see whether they contain poison information directed at a specific device, for example because all ECM's have the same length and are encrypted. Thus a hacker permanently risks that his or her secure device will be disable when decrypting content data.

Although the invention has been described for "poison data", i.e. data aimed at disabling entitlements in a selected secure device, it will be understood that the invention can be applied to other updates of entitlement information that should not be blocked.